The Philippines and the adjoining regions of the ocean may be said to cover lats. 5° to 20°. The average hourly velocity for these latitudes according to Table 11 is approximately 11 nautical miles, which is well within the limit set by Father Algué.

Doberck gives the following average velocities of typhoons: [18]

Latitude	11°	13°	15°	20°	25°	30°	30.5°	Extremes
Velocity m. p. h	5	6.5	8	9	11	14	17	6–36
Kilometers	9	12	15	17	20	26	31.5	11–67

The velocities as given by Doberck are about 4 miles per hour lower than those given in Table 11 for the same latitudes. The Zikawei Observatory at Shanghai has recently issued a pamphelet entitled "Code de Signaux, 1918," in which there is a tabulation of the mean and extreme velocities of typhoons at different latitudes before and after recurvature. The following data are abstracted from that pamphlet.[19]

Average velocity of typhoons in nautical miles per hour

Latitudes	5–15	15–20	20–25	25–30	30–35	35–40	40–50
Before recurvature	9	10	11	11	------	------	------
After recurvature	------	10	17	18	20	21	21

For the sake of comparison, the results obtained in the present investigation are here again tabulated:

Latitudes	5–10	10–20	20–30	30–40	40–50
Mean velocity, m. p. h	10.8	10.9	16.7	20.7	23.3

The average velocities as given in the above two tables agree remarkably well. It appears therefore that the velocity of typhoons as given by Doberck is too low. Further, Doberck gave the velocity at lat. 30° N. as 14 miles an hour, and 30.5° N. as 17 miles an hour. It hardly seems as if a difference of half a degree of latitude could make as much difference as 3 nautical miles an hour in the average velocity.

[18] Doberck; "The Law of Storms in the Eastern Sea," 1898, p. 16; see also Hann, "Lehrbuch der Meteorologie," 1915, p. 607.

[19] "Code de Signaux, 1918." Extrait du Calendrier-annuaire pour, 1918. Zikawei, près de Changhai, 1917, p. 15–16. Compare also Louis Froc, "Atlas of the Tracks of 620 Typhoons, 1893–1918," Tables Nos. 1 and 2.

CONCLUSIONS

One of the most important problems connected with typhoons is the immediate cause of these remarkable phenomena. In order to solve this problem, it is necessary to have a network of weather stations in the regions of the west Caroline and the Ladrone Islands, to have complete and accurate observations of the surface pressure and wind conditions, and also to secure meteorological records from the upper air 5 or 10 kilometers above the surface. Without such data any theory that may be advanced in explanation of the origin of typhoons necessarily rests upon rather insecure foundations. What at present can be done is to organize the material which has already been obtained by the various meteorological observatories in the Far East, and thus to throw some light upon the question. A clear and well-defined classification of typhoons is a step in that direction, for the various types of typhoons not only come in different seasons and visit different regions, but also differ in their point of origin. Besides giving a new classification, the present discussion has brought out three points which need emphasis.

In the first place, the word "typhoon" has been given a definite meaning. While hitherto "typhoon" has been used to denote almost all the tropical storms which have been observed in the Far East, and in a few cases even to include extratropical cyclones, the term has been defined to mean a well-developed tropical storm in the Far East in which a wind velocity of Beaufort scale 6 or more has been observed. Standardization of the term is necessary in order to make the reports of different observatories on typhoons strictly comparable.

Secondly, in the past the storm tracks have been studied by plotting the mean tracks. These mean tracks are ususally too much generalized and give very little idea as to the limits of the area frequented by the storms and their relative frequency in the different regions. In the present paper the typhoon tracks are studied by means of charts of composite tracks of the different months. Thus the storm tracks of a certain month in a given period are presented graphically as a whole.

Certain new facts connected with the pressure, temperature, and wind conditions in the center of typhoons, reported during the 12 years from 1904 to 1915, have been collected and given by the writer in a condensed form [20] in a previous paper.

[20] Chu, Co-Ching, Some New Facts about the Centers of Typhoons. MO. WEATHER REV., September 1918, 46: 417–419.

PRESSURE OVER THE NORTHEASTERN PACIFIC, AND WEATHER IN THE UNITED STATES, DECEMBER, 1924, AND JANUARY, 1925

By ALFRED J. HENRY

SYNOPSIS

This paper is an attempt to show the relation between the pressure distribution over the North Pacific Ocean, east of about the 180th meridian of west longitude, and the weather of the United States for corresponding periods.

The pressure charts used were those for the Northern Hemisphere prepared twice daily in the Forecast Division of the central office of the Weather Bureau.

It is fully realized that useful precepts for forecasting weather some days in advance, or other form of generalization can not safely be drawn from the record of a single month or so; nevertheless the most important tendencies may be pointed out. These are:

(1) A barometric minimum over the Gulf of Alaska or the Aleutians with fully developed cyclonic wind circulation does not readily pass inland as such, but rather oscillates back and forth with at times increasing and at times decreasing pressure at its center, until the conditions are favorable for (*a*) the passage of the cyclone in its entirety inland, evidently a very rare occurrence, or (*b*) the entrance of a mass of warm and moist air from it over the continent which later may or may not form a cyclone.

(2) The Aleutian or Northeast Pacific LOW must be considered as the origin of the great majority of low-pressure systems (cyclones) that pass from west to east across the Rocky Mountains. While at times it is difficult to trace the LOWS in a continuous path back to the Pacific, it seems reasonably certain that the original impulse that created them came from the Pacific.

(3) The most interesting and important place for study is the point of first contact of oceanic cyclones with the shore line of the continent where pronounced discontinuities in both temperature and moisture must be found.

THE NORMAL PRESSURE DISTRIBUTION OVER THE NORTH PACIFIC

The average pressure distribution over the North Pacific Ocean is characterized by two very pronounced formations, one of average low pressure, the other of average high pressure, often referred to in the nomenclature of Tiesserenc de Bort as "centers of action" of the atmosphere but commonly known as the Aleutian LOW and the North Pacific HIGH, respectively. In order that a clear understanding of both of these may be had the following details, most of which are already well known, are given:

The Aleutian Low.—A meteorological station has been maintained intermittently on Unalaska Island, one of the three larger islands of the Aleutian group, for a number of years. The station was originally known as Unalaska, but is better known at present as Dutch Harbor, the site of a small settlement and a high-power radio station maintained by the United States Navy.

The fact that atmospheric pressure was nearly always low in the cold season at this station was clearly shown by Signal Service observations of a quarter of a century ago; hence the descriptive term Aleutian LOW has come into rather general use. It should be remembered, however, that the center of low pressure in that part of the globe may at times be a thousand miles distant from the Aleutian group.

Neither the so-called Aleutian LOW or the North Pacific HIGH should be thought of as definite entities which preserve at all times the form and position as portrayed in textbooks and meteorological atlases. Both formations are subject to the seasonal and accidental pressure changes common to the latitude in which they are found. During periods of time ranging from 3 to 10 days the pressure in the regions normally occupied by these two formations may be completely reversed. [See fig. 2, December 16, (a. m.).] Such reversals are, however, of infrequent occurrence.

The Aleutian LOW as portrayed in Weather Bureau Bulletin A appears as a long, narrow region of low pressure that stretches nearly 3,000 miles almost due west from a point on the Alaskan coast at about 55° north latitude. Average pressure in or near the center of this area is lowest—29.58 inches—in December. From that minimum it increases very slowly in the remaining winter months, more rapidly in spring, until in July it has risen to about 30 inches. At this time the center of lowest pressure appears to be in much higher latitudes.

The North Pacific High.—According to Bartholomew's Atlas the January position of this HIGH is near the intersection of the parallel of 30° North latitude and the meridian of 140° West longitude. As the season advances the center of this HIGH is found farther and farther to the west and northwest of its January position, so that in August it is located approximately at 36° north, 150° west. With the approach of the cold season it begins a retrograde movement toward the continent. Pressure at the center of this HIGH averages 30.10 inches in October and rises from that level to 30.30 inches in April, continuing at that level until October. Analogous pressure formations are also found in the eastern North Atlantic Ocean.

THE PERIOD DECEMBER 1–9 OVER THE NORTH PACIFIC

The dominant pressure control during the above-named period was an extensive area of low pressure centered over the Northeastern Pacific as indicated in the table below.

Dutch Harbor, whose geographical coordinates are 53° 55′ N. lat., 166° 30′ W. long., may be considered as a point of reference for determining the fluctuations in the position of the center of the North Pacific LOW in the table.

Approximate position of Aleutian Low,[1] December 1–9, 1924

Date	West longitude	North latitude	Pressure
			Inches
Dec. 1	147	52	29.20
Dec. 2	154	49	29.20
Dec. 3	147	52	29.00?
Dec. 4	157	52	29.50?
Dec. 5	[2] 175	45	29.50
Dec. 6	174	46	29.10?
Dec. 7	157	52	29.10?
Dec. 8	150	56	28.64
Dec. 9	150	45	28.50

[1] Considerable uncertainty exists as to the exact location of the center of the LOW on many of the dates.
[2] East longitude.

The shifting in latitude and longitude as shown in the above table is, in part, more apparent than real, due to the lack of radio reports on successive days for approximately the same part of the ocean. Unless the number of radio reports is greatly increased it will be generally impracticable to locate the center of a barometric depression with an accuracy of less than about 500 miles.

On December 4 there is clear evidence of a new cyclone approaching from the west; two days later this new cyclone has lost its individuality by merging with the general depression in the vicinity of the Aleutians. Four days later the center of the combined depression passed Kodiak Island but evidence still persisted of cyclonic activity in approximately N. lat. 35°, W. long. 163°. The foregoing illustrates the fact elsewhere stated by the writer that the Aleutian group of islands is merely a port of call for North Pacific cyclones and that it is difficult by reason of lack of sufficient observations to distinguish between the several cyclones which touch at and pass Dutch Harbor.

Three days later, December 11 [see fig. 1, December 11 (a. m.), and fig. 2, December 16 (a. m.], pressure over the western Aleutians and for a great part of the Northeast Pacific had risen above 30 inches and the end of the LOW that we have been considering was in sight.

Rising pressure in this case seemed to come from the northeast, or the interior of northern Alaska.

Attention is now directed to a consideration of the relations that appear to subsist between the pressure distribution that has just been described and the weather in the United States. On December 1 (see daily weather map of that date)[1] the outer isobar of the oceanic LOW, that of 29.90 inches, had penetrated northwest Washington and British Columbia. The temperature in that region had risen and precipitation had set in, indications that the influence of an oceanic LOW was being felt.

Figure 1—December 1, 8 p. m.—shows the pressure distribution at the evening observation of that date; note the isobars curving inland over the Washington and Oregon coast and thence northward. The conditions for the formation of a vigorous LOW at the surface at this time were not good. Radio reports from the Pacific on the p. m. of the 1st showed the presence of a vigorous anticyclone off the California coast, and the land observations on the morning of the 2d showed that this anticyclone, attended by lower temperature and rising pressure—two conditions inimical to cyclonic development—was passing inland over this Oregon coast.

[1] Frequent reference will be made to the daily weather maps throughout this paper. The Washington printed map, Form C, is meant in all cases.

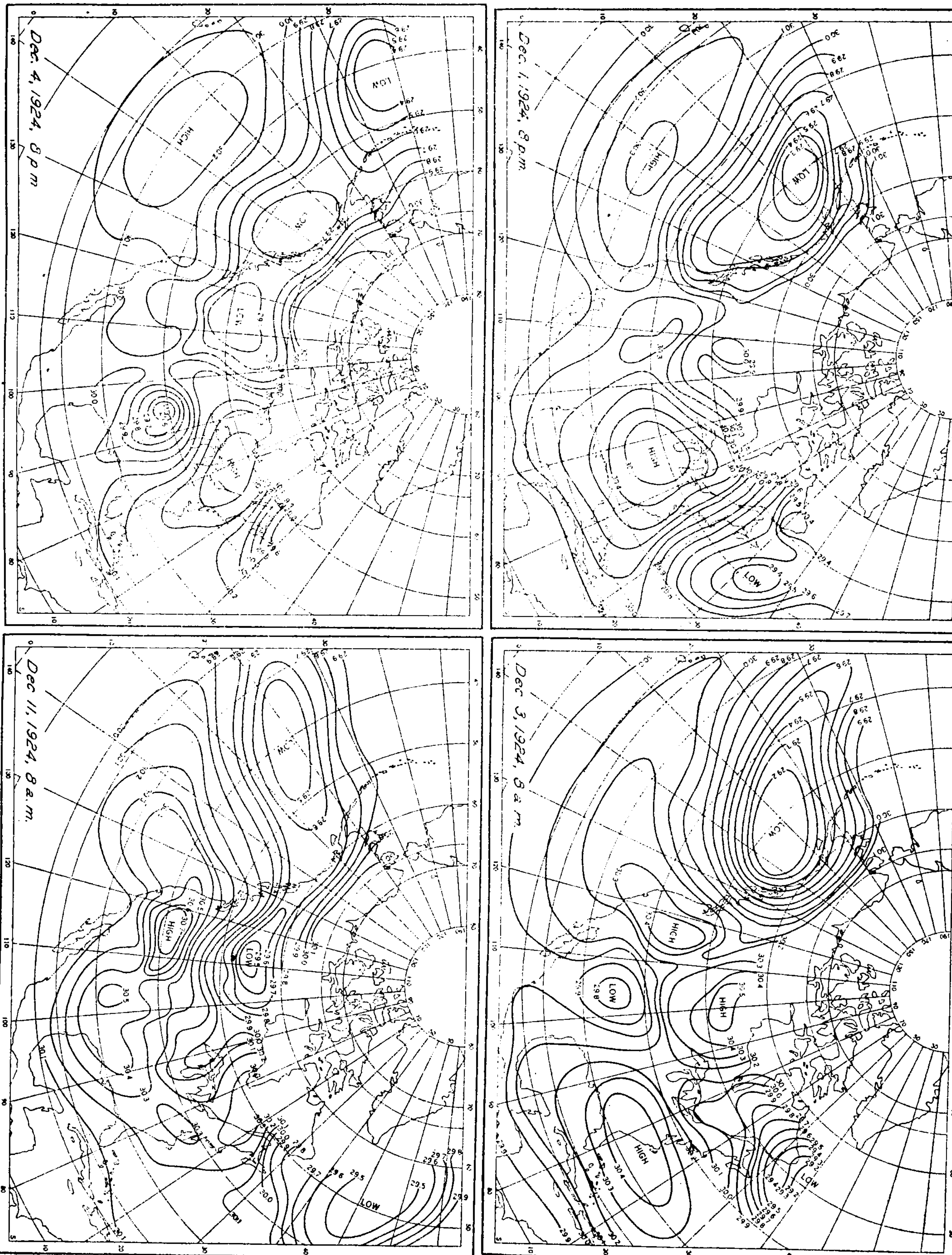

FIG. 1.—Weather charts, part of Northern Hemisphere, December 1 (a. m.), December 3 (a. m.), December 4 (p. m.), and December 11 (a. m.).

Figure 1, chart of December 3, 8 a. m., shows the surface conditions after the anticyclone of the preceding paragraph had passed inland. Attention is directed to two formations on this chart: First, to the cyclone over the Texas Panhandle, and second, to the saddle pressure formation between the two anticyclones in the Canadian Northwest. The origin of the cyclone, it is believed, may be referred to the oceanic cyclone of the 1st, and it illustrates the view that the lower part of the air column in cyclones that derive their energy from oceanic cyclones of the Pacific is separated from the upper or free air portion as the latter passes unimpeded across the mountain regions of the West.[2] Obviously this is not the whole story.

Saddle pressure formations generally are favorable to the development of a cyclone or the discharge of a secondary from the oceanic cyclone.

The effect of the inland movement of the anticyclone figured in the chart of December 3 (a. m.) upon the development of a cyclone over Washington and British Columbia was suddenly to deprive it of its supply of warm moist air. It was as if the advanced portion of the oceanic LOW which had passed a short distance inland were snipped off, as with a gigantic pair of shears, and thus completely isolated from the source of its energy. Even so there were, in this case, rains along the coast, scattered snows over the plateau and pressure continued to fall progressively farther and farther eastward, so that by the morning of the 3d a circular depression appeared over New Mexico.

At this time the oceanic LOW was centered south of Kodiak Island and was being renewed by the advance of new cyclones from the west.

On the morning of the 4th this cyclone again came into contact with the shore line, the isobar of 29.70 inches extending from Tatoosh Island NE. to Edmonton in Alberta. Rain had set in along the coast and pressure had fallen 0.3 inch. In this the second attempt the conditions for the formation of a cyclone extending down to the surface were better than in the first attempt, and accordingly we find at the p. m. observation of that date a circular depression over Montana and the Canadian Northwest; by this time the New Mexico depression had advanced toward the northeast so as to be directly in line with the newly formed Montana depression and two others still over the Pacific were also in line with it. This rather unusual situation, four separate cyclones in tandem formation, is portrayed in Figure 1, chart for December 4 (p. m.).

A situation such as this, while rather unusual, arises not infrequently. It arises whenever the reaction[3] to high pressure in the rear of the separate depressions is, for reasons which are not now apparent, weak or wholly absent.

At the p. m. observation of the 5th, pressure in the United States was everywhere, except along the Atlantic coast and in New England, below 30 inches, a condition favorable to the entrance of cyclones from the Pacific. And this maximum development of low pressure seems to have been the cause of its own extinction. Beginning at the p. m. observation of the 6th, anticyclonic conditions began to progress southward and westward over the Missouri Valley and continued to dominate the weather of the United States until the morning of the 11th when the barometric formations appeared as shown in the chart for that date given in Figure No. 1.

The significance of a pressure distribution of the nature shown will be realized when it is considered that on the northern margin of the great continental HIGH the gradient will be for fresh westerly winds up to, say, 3 or 4 km., if not higher. Immediately to the north of the great HIGH as illustrated in Figure 1 [chart for December 11 (a. m.)] it will be noticed that a cyclone, an offshoot from the Pacific cyclone, has already advanced a considerable distance inland. A strong rise in pressure in the rear of the oceanic LOW of the 11th seems to have entirely obliterated that LOW and 24 hours later, December 13, the continental LOW was the sole representative of the two depressions shown on the chart of December 11 (a. m.).

The oceanic LOW that has been under discussion endured from the 1st until the p. m. of the 12th. During its existence four cyclones were given off, of which the most intense were the two later ones. The intensity of these later cyclones as measured by the gradients produced was in no small measure responsible for the equatorward flow of cold air that terminated the life of the cyclones.

Thus far in the discussion the sequence of cyclone-anticyclone-cyclone has been comparatively simple. With the subsequent formation of a great continental and oceanic HIGH, a new order sets in.

The first striking evidence of this appeared on the Northern Hemisphere chart for the morning of the 13th. (Not reproduced.) On this chart there was a trough of low pressure extending from the Texas Panhandle to the Gulf of Alaska. This trough was flanked on the north by a great anticyclone centered in interior Alaska, and on the south by another large anticyclone centered over the Great Basin of the western United States. As the pressure in Alaska rose, the result seemed to be a squeezing of the trough as between a pair of powerful pincers. On the 14th the trough appeared as a long NW.-SE. oval-shaped depression with lowest pressure 29.60 inches in Montana. (See Weather Bureau map of that date.) During the next 24 hours the northern end of this depression was evidently reinforced by an incipient cyclone from the Pacific because we find centered over the State of Washington on the morning of the 15th a circular depression of 29.45 inches central pressure, with a well-marked warm front. The greatest northing of this warm front was at Spokane, Wash., close to the center of the LOW. The extent of the warm front is shown by the table following:

TABLE 1.—*Temperature departures from normal at 8 a. m., 75th meridian time, at the stations named*

Stations	Elevation	December, 1924					
		12	13	14	15	16	17
	Feet						
Seattle, Wash.	125	+9	+12	+9	−17	−25	−30
Spokane, Wash.	1,929	+20	+20	+13	+16	−30	−30
Kalispel, Mont.	2,973	+23	+27	+21	−13	−32	−33
Havre, Mont.	2,505	+33	+11	+5	−33	−43	−41
Williston, N. Dak.	1,872	+34	+14	+6	−10	−32	−32
Devils Lake, N. Dak.	1,482	+24	−6	−10	−4	−32	−32
Duluth, Minn.	1,133	+8	−16	−26	−6	−22	−28
Yellowstone Park	6,200	+12	+12	+16	+16	−38	−46

This warm front was being pushed back toward the southwest by the advance of cold air from the Canadian Northwest. (See fig. 2 and the chart for December 16,

[2] Cf. T. Kobayasi, On a Cyclone Which Crossed the Corean Peninsula and the Variations of Its Polar Front. Quart. Jour. Royal Met. Soc., 48:169–183.

[3] The term "reaction" is used in its mechanical sense, as exemplified in the third law of motion. If, for example, falling pressure be considered negative, then rising pressure may be considered as positive. The "down and up" movements in the pressure curve are, however, only roughly equal and oppositely directed, as in the mechanical sense.

which shows the LOW in a position almost due south of that which it had 24 hours previously.) On the morning of the 16th surface temperature in Montana, northern Idaho, and northeast Washington had sunk to zero and below. Pressure at the center of the LOW had now dropped to 29.26 inches.

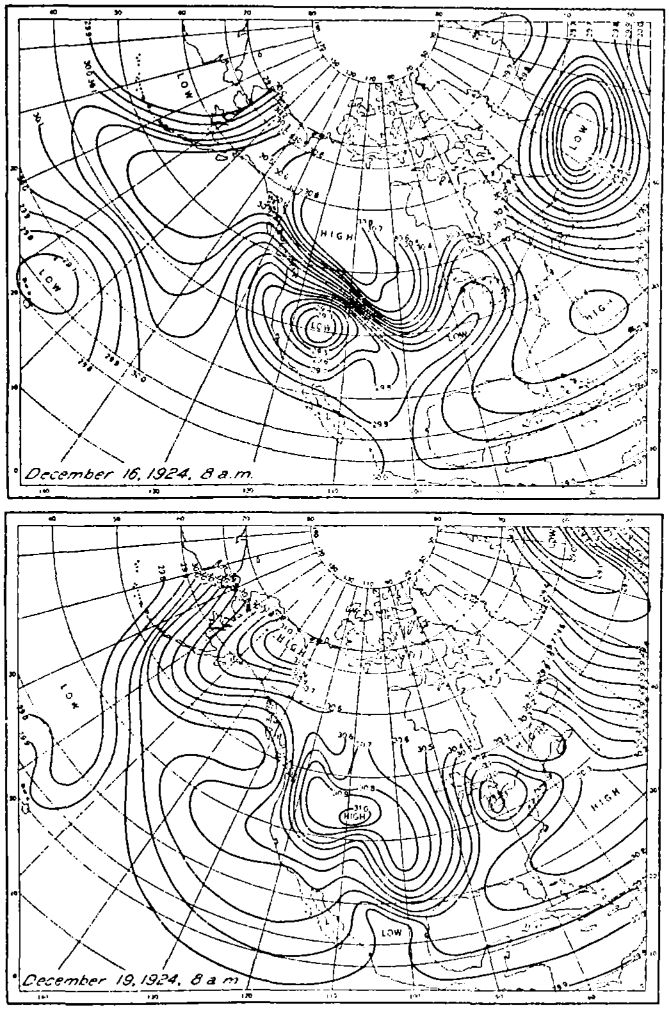

FIG. 2.—Weather charts, part of Northern Hemisphere, December 16 and 19 (a. m.). Isotherms are not drawn over water areas and have been omitted from the land in the interest of simplicity. The range in temperature on the chart for December 16 between the HIGH over western Canada and the LOW over the Great Basin in the United States was 85° F. or from −40° to 45° F. The winds in the region where the isobars are so greatly crowded were light northerly, force 2. In the northeast quadrant of the LOW moderate to fresh southerly winds prevailed. The indicated barometric gradient is largely due to the surface temperatures used in the sea-level reduction and is to that extent artificial.

The reason for this fall in pressure is not apparent; ordinarily a fall in pressure might be expected, if and when the temperature of the air column rises, or if the gyratory motion of the whirl greatly increases. Since, however, the whirl was centered over an elevated plateau in dry and cold air and since the movement of the LOW was into lower latitudes it would be reasonable to expect higher, rather than lower, central pressure. Eventually the central pressure in this LOW rose to 30.05 inches. (See fig. 2, chart of December 19.)

THE HIGH PRESSURE PERIOD DECEMBER 19–21, 1924

Reference to Northern Hemisphere weather charts for the dates mentioned will show that unusually high pressure was experienced west of the Mississippi, a maximum of 31.22 inches being recorded at Lander, Wyo., on the 20th.[4]

This period of high pressure in the United States and the Candian Northwest endured practically until the end of the month, diminishing somewhat, however, on the California coast on the 22d and again on the coast of British Columbia and the State of Washington during the 27th to 31st.

PRESSURE CONTRASTS DURING JANUARY, 1925

Since writing the foregoing advantage has been taken of the opportunity to examine the Northern Hemisphere weather charts of January, 1925.

I have scaled from the daily charts of both December, 1924, and January, 1925, the pressure at the intersection of N. lat. 35° and W. long. 140°, the geographical coordinates of the approximate center of the North Pacific HIGH for these months. The monthly means computed from the scaled values are for December 30.14 inches and for January 30.23 inches, therefore, broadly speaking, pressure in this HIGH was somewhat below normal in December and above in January.

The average daily values for the first and second halves of January were 30.41 inches for the first half and but 30.08 for the last half, showing that there was a decided diminution of pressure in the last half as compared with the first. I also computed the daily mean pressures for Dutch Harbor in the Aleutians and Eagle, in interior Alaska, for the corresponding periods. Both of these stations experienced higher pressure in the second than in the first half, the excess being 0.41 inch for Dutch Harbor and 0.52 inch for Eagle, or the reverse of the pressure distribution in the North Pacific HIGH. It has been tacitly assumed that the same sort of reciprocal relation exists between the pressures in the North Pacific HIGH and the Aleutian LOW that are known to exist between the Azores HIGH and the Iceland LOW of the eastern North Atlantic.

The facts as above confirm this impression. That there may be no misunderstanding these facts are restated as follows: (1) The North Pacific HIGH during the first half of January, 1925, was fully developed and in approximately its normal position; (2) pressure in Alaska was low relative to that in the North Pacific HIGH in the first half of the month and higher in the interior during the second half, the reverse of the conditions which existed during the first half.

What then is the significance of the change that took place in pressure distribution in the second half of January, 1925?

The answer, whatever it may be, should contain a reservation that only a provisional one is possible at this time.

High pressure in interior Alaska must furnish the mechanical energy necessary to drive polar air far to the southward, provided there are no unsurmountable obstacles in the way. The earth's surface does not provide obstacles of moment, but the atmosphere itself may determine both the direction and the strength of the equatorward flow.

Examining the daily weather maps of the United States Weather Bureau for both halves of January, assuming of course that the last half, though it contains 16 days, is practically equal to the first half of but 15

[4] Probably at least a tenth of an inch too high due to the very low temperature, locally at the station, when the observation was made.

days, I have not been able to find any very striking differences between the weather of the two halves of the month.

There was greater cyclonic activity during the second half than in the first, the weather was more changeable, and there was a pronounced southward and eastward flow of polar air on the 26th–28th. On the whole, the differences were not important. The temperature and precipitation were both rather close to the normal, so close that we feel justified in characterizing it as an average winter month.

HAWAIIAN RAINFALL

By ALFRED J. HENRY

The recent publication by the Weather Bureau of statistics of rainfall and other climatic data for Hawaii[1] puts in convenient form for study the individual monthly amounts of rainfall as recorded for each month of the year at 59 stations in Kaui, 120 in Hawaii, 72 in Maui, and 77 in Oahu, 2 in Lanai, and 5 in Molokai, a total of 335 records, but not necessarily for that number of individual stations, there being in a number of cases several records of observation for one and the same place. An attempt has not been made to consolidate the several series just mentioned into a single consecutive series.

The object of this paper is to draw attention to the statistical data thus made available and to very briefly touch upon some of the best-known characteristics of Hawaiian rainfall.

The outstanding feature of the rainfall distribution in Hawaii is the very wide variation from one place to another separated from each other by only a few miles, also by the wide variation in the amounts for the same months in different years.

As much as 31.95 inches of rain have been registered as falling on a single day and 102.46 inches in a single month of 31 days, or an average of 3.30 inches on each day of the month. The annual amounts range from a maximum of 562.00 to a minimum of 2.46 inches on the island of Maui.

Mean monthly and annual rainfall, by islands.—Table 1 below gives the monthly and annual means for each of the four large islands of Hawaii, Kaui, Oahu, and Maui. The monthly means were computed from the records of 10 years or more in length on each of the several islands and were taken from the regular monthly publication Climatological Data, Hawaiian Section, 1923, by Thomas A. Blair.

The small number of stations on both Lanai and Molokai and their geographic distribution make it inadvisable to attempt to compile a mean for those islands.

TABLE 1.—*Average monthly precipitation, Hawaiian group, by islands*

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Hawaii	9.15	8.65	10.58	**11.03**	8.26	*5.87*	8.18	10.11	7.42	6.25	10.90	10.29	106.69
Kaui	5.84	4.60	7.66	4.27	3.94	*3.40*	5.60	6.11	6.39	5.98	8.25	**8.29**	70.33
Maui	5.81	7.51	8.65	10.20	7.35	5.82	7.67	9.85	6.84	*5.42*	10.37	**11.20**	96.69
Oahu	6.01	5.97	6.31	5.59	4.12	*3.44*	3.48	4.05	4.65	3.93	6.32	**7.87**	61.74
Group mean	6.70	6.68	8.30	7.77	5.92	4.63	6.23	7.53	6.32	5.39	8.96	9.41	83.84
Adjusted 30-day mean	6.50	7.01	8.05	7.77	5.74	4.63	6.04	7.30	6.32	5.23	8.96	9.13	------

[1] Summary of the Climatological Data for the United States, by Sections, Washington, 1922. In Figure 3 of this publication, the block with the title "Oahu (Mountains) Leeward" needs a word of explanaton in view of the well-known decrease of rainfall on the leeward side of the mountains.

The author of the publication in an unpublished letter indicates that the block as above indicated refers exclusively to that part of the Ko-o-lau Range extending from its crest a few miles to windward. It is recalled that the average altitude of these mountains is not more than 2,000 feet, not high enough to block the passage of the northeast trades. The rain that falls immediately in lee of the crest should be considered in the nature of an oversplash from the rain that falls on the windward side.—EDITOR.

The monthly means of the above table are to be considered as provisional rather than definitive. In computing the monthly means regard has been had primarily to length and reliability of the record rather than to geographic position on the islands.

It is perhaps well known that the majority of rainfall stations on the islands are at low levels and on the windward side, whence it follows that the island mean will be increased when a majority of the stations thereon have a windward exposure. It is believed that the means of Table 1 for both Hawaii and Maui are too large by reason of the disparity between the number of rainfall stations on the respective windward and leeward exposures. In the case of Molokai but two records are available, one of which is on the windward coast, the other being in the interior at an elevation of 800 feet. The annual average at the first named is 67.03 and at the last 34.82 inches. Lanai has but a single reporting station, situated nearly in the middle of the island at an elevation of 1,780 feet. The annual average is 35.70 inches.

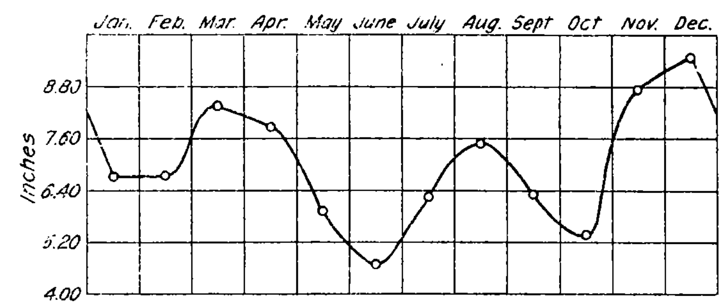

FIG. 1.—Composite curve of monthly rainfall distribution

Monthly distribution.—The group monthly means show three rather distinct maxima, one each in March, August, and December and three minima, one each in February, June, and October. Figure 1 presents these facts graphically. The chief maximum occurs in December and the chief minimum in October. These are most likely the more stable of the phenomena of monthly distribution. The August maximum is largely dependent upon the intensity and position of the North Pacific area of high pressure, which usually is centered about north latitude 40° and west longitude 145°; the spring maximum, which on Hawaii is deferred until April, is probably in some way related to the increased wind movement of that season coupled with the frequency of occurrence of southerly storms.

The chief minimum, which on Maui is deferred until October, comes in early summer at a time when cyclonic activity to the northward of the islands is at a low ebb and the pressure gradient for northeast winds is at the lowest point for the year. This minimum is most pronounced on Kaui and Oahu and on the leeward slopes of Maui, Molokai and in a much less degree in the Kau district of Hawaii.